

WHAT IS CLAIMED IS:

1. An isolated and purified beta-expansin protein comprising the following characterisitcs:

- 5 a) a His Phe Asp Leu Ser Gly motif,
 b) is found in plant cell walls, and
 c) having one or more functional characteristics of beta-expansins such as inducing expansion or stress relation on grass cell walls more effectively on monocot cell walls than on dicotyledon cell walls as determined by cell wall extension and/or stress relation assays.

10 2. An isolated and purified beta-expansin protein comprising the following characterisitcs:

- a) a Thr Trp Tyr Gly motif,
 b) is found in plant cell walls, and
 c) having one or more functional characteristics of beta-expansins such as inducing
15 expansion or stress relation on grass cell walls more effectively on monocot cell walls than on dicotyledon cell walls as determined by cell wall extension and/or stress relation assays.

3. An isolated and purified beta-expansin protein comprising the following characterisitcs:

- a) a Gly Gly Ala Cys Gly
20 b) is found in plant cell walls, and
 c) having one or more functional characteristics of beta-expansins such as inducing expansion or stress relation on grass cell walls more effectively on monocot cell walls than on dicotyledon cell walls as determined by cell wall extension and/or stress relation assays.

4. An isolated and purified beta-expansin protein comprising the following
25 characterisitcs:

- a) a His Phe Asp motif,
 b) is found in plant cell walls, and
 c) having one or more functional characteristics of beta-expansins such as inducing
expansion or stress relation on grass cell walls more effectively on monocot cell walls than
30 on dicotyledon cell walls as determined by cell wall extension and/or stress relation assays.

5. An isolated and purified protein, characterized by the following:

- a) a group I grass pollen allergen structurally and functionally related to an expansin protein;
- b) inducing extension of a plant cell wall;
- c) inducing stress relaxation of a plant cell wall;
- 5 d) a 25% or less sequence similarity with an alpha-expansin; and
- e) a His Phe Asp Leu Ser Gly motif based on the conserved amino acid sequences of the seven beta-expansin proteins shown in Figure 5 as determined by BLAST or FASTA algorithms (when compared to alpha-expansins).

10 6. The protein, or fragment thereof, of claim 5 wherein said protein is a member of the beta-expansin family.

7. The protein, or fragment thereof, of claim 5, further comprising an amino acid alignment of a Thr Trp Tyr Gly motif based on the conserved amino acid sequences of the
15 seven beta-expansin proteins shown in Figure 5 as determined by BLAST or FASTA algorithms (when compared to alpha-expansins) and wherein said beta-expansin induces extension or stress relaxation of a plant cell wall material.

8. The protein, or fragment thereof, of claim 5, further comprising an amino acid
20 alignment of a Gly Gly Ala Cys Gly motif based on the conserved amino acid sequences of the seven beta-expansin proteins shown in Figure 5 as determined by BLAST or FASTA algorithms (when compared to alpha-expansins) and wherein said beta-expansin induces extension or stress relaxation of a plant cell wall material.

25 9. The protein, or fragment thereof, of claim 5, further comprising an amino acid alignment of a His Phe Asp motif based on the conserved amino acid sequences of the seven beta-expansin proteins shown in Figure 5 as determined by BLAST or FASTA algorithms (when compared to alpha-expansins) and wherein said beta-expansin induces extension or stress relaxation of a plant cell wall material.

30 10. The protein, or fragment thereof, of claim 5, further comprising an amino acid sequence selected from the group consisting of SEQ ID NO:10, SEQ ID NO:11, SEQ ID NO:12, SEQ ID NO:13, SEQ ID NO:14 and SEQ ID NO:15.

11. The protein, of claim 5, wherein said beta-expansin protein is isolated and purified from a monocotyledonous species.

12. The protein, of claim 5, wherein said beta-expansin protein is recombinantly produced from a monocotyledonous species.

13. The protein, of claim 5, wherein said beta-expansin protein is selected from the group comprising: a vegetative homolog of a group I grass pollen allergen or an isolated polynucleotide encoding said beta-expansin.

14. The protein, of claim 5, wherein said beta-expansin protein is isolated and purified or recombinantly produced from a dicotyledonous species.

15. An isolated and purified protein, or fragment thereof, characterized by the following:

- a) a group I grass pollen allergen structurally and functionally related to an expansin protein;
- b) inducing extension of a plant cell wall;
- c) inducing stress relaxation of a plant cell wall;
- d) a 25% or less sequence similarity with an alpha-expansin; and
- e) a Gly Gly Ala Cys Gly motif based on the conserved amino acid sequences of the seven beta-expansin proteins shown in Figure 5 as determined by BLAST or FASTA algorithms (when compared to alpha-expansins).

16. The protein, or fragment thereof, of claim 15, wherein said protein is a member of the beta-expansin family.

17. The protein, or fragment thereof, of claim 15, further comprising an amino acid alignment of a Thr Trp Tyr Gly motif based on the conserved amino acid sequences of the seven beta-expansin proteins shown in Figure 5 as determined by BLAST or FASTA algorithms (when compared to alpha-expansins) and wherein said beta-expansin induces extension or stress relaxation of a plant cell wall material.

18. The protein, or fragment thereof, of claim 15, further comprising an amino acid alignment of a His Phe Asp motif based on the conserved amino acid sequences of the seven beta-expansin proteins shown in Figure 5 as determined by BLAST or FASTA algorithms (when compared to alpha-expansins) and wherein said beta-expansin induces extension or stress relaxation of a plant cell wall material.

19. The protein, or fragment thereof, of claim 15, further comprising an amino acid sequence selected from the group consisting of SEQ ID NO:10, SEQ ID NO:11, SEQ ID NO:12, SEQ ID NO:13, SEQ ID NO:14 and SEQ ID NO:15.

20. The protein, of claim 15, wherein said beta-expansin protein is isolated and purified from a monocotyledonous species.

21. The protein, of claim 15, wherein said beta-expansin protein is recombinantly produced from a monocotyledonous species.

22. The protein, of claim 15, wherein said beta-expansin protein is selected from the group comprising: a vegetative homolog of a group I grass pollen allergen or an isolated polynucleotide encoding said beta-expansin.

23. The protein, of claim 15, wherein said beta-expansin protein is isolated and purified or recombinantly produced from a dicotyledonous species.

24. A protein comprising one or more functional characteristics of a beta-expansin such as inducing extension or stress relaxation of a plant cell wall material, is more effective on monocotyledonous plant cell walls than on dicotyledonous plant cell walls, is determined using cell wall extension and stress relaxation assays, and which has a His Phe Asp Leu Ser Gly motif based on the conserved amino acid sequences of the seven beta-expansin proteins shown in Figure 5, when said sequence is aligned with an amino acid sequence selected from the group consisting of SEQ ID NO:10, SEQ ID NO:11, SEQ ID NO:12, SEQ ID NO:13, SEQ ID NO:14 and SEQ ID NO:15 as determined by Clustal alignment algorithm.

25. A protein, said protein comprising one or more functional characteristics of a beta-expansin such as inducing extension or stress relaxation of a plant cell wall material, is more effective on monocotyledonous plant cell walls than on dicotyledonous plant cell walls, is determined using cell wall extension and stress relaxation assays, and has a Gly Gly Ala Cys Gly motif based on the conserved amino acid sequences of the seven beta-expansin proteins shown in Figure 5, when said sequence is aligned with an amino acid sequence selected from selected from the group consisting of SEQ ID NO:10, SEQ ID NO:11, SEQ ID NO:12, SEQ ID NO:13, SEQ ID NO:14 and SEQ ID NO:15 as determined by Clustal alignment algorithm.

26. A purified and isolated beta-expansin protein, said beta-expansin protein being present in grass pollen and comprises a His Phe Asp Leu Ser Gly motif based on the conserved amino acid sequences of the seven beta-expansin proteins shown in Figure 5 and wherein said protein having a property of inducing extension or stress relaxation of a plant cell wall material.

27. The purified and isolated beta-expansin protein, of claim 26, the beta-expansin protein further comprising: a Gly Gly Ala Cys Gly motif or a Thr Trp Tyr Gly motif or a His Phe Asp motif based on the conserved amino acid sequences of the seven beta-expansin proteins shown in Figure 5 of said beta-expansin protein and wherein said protein having a property of inducing extension or stress relaxation of a plant cell wall material.

28. The purified and isolated beta-expansin protein, or fragment thereof of claim 26, said fragment having a property of inducing extension or stress relaxation of a plant cell wall material, wherein said beta-expansin is a vegetative homolog of a group I grass pollen allergen or an isolated polynucleotide encoding said beta-expansin and is not of soybean origin.

29. The polynucleotide of claim 28 having a molecular weight from about 24 kDa to about 35 kDa.

30. The protein, or fragment thereof, of claim 26, said beta-expansin being of a dicotyledonous origin, said fragment having a property of inducing extension or stress relaxation of a plant cell wall material, wherein said beta-expansin is not of soybean origin.

31. A method for cloning a polynucleotide encoding a beta-expansin comprising the steps of:

- a) preparing a genomic or a cDNA library from an organism of interest, and
- b) using a conserved expansin polynucleotide (i) as a probe to screen said library or (ii) as a primer to amplify polynucleotide fragments from said library.

32. The method of claim 31, wherein said polynucleotide has the functional characteristics of altering physical properties of a plant cell wall material comprising the step of contacting said material with said polynucleotide encoding a beta-expansin.

33. A method for detecting and identifying a beta-expansin protein, comprising the steps of:

- a) isolating a vegetative homolog of the group I grass pollen allergens;
- b) inferring a phylogenetic relationship of said beta-expansin protein to the phylogenetic tree of Figure 4, said tree having been prepared from the reference sequences shown in Figure 5, with the use of sequence analysis software; and
- c) locating the placement of said sequence with respect to the initial branch point, as shown in Figure 4;
- d) characterizing said beta-expansin by the functional characteristics of inducing extension or stress relaxation of a plant cell wall material,
- e) determining the sequence to be said beta-expansin by falling within the branch point comprising group I grass pollen allergens and homologs as opposed to an alpha-expansins.

34. The method of claim 33 wherein said tree is constructed by aligning protein sequences using the Clustal program with PAM250 analysis weight table and bootstrap analysis using nearest neighboring joining of Poisson-corrected values.

35. A composition comprising:

- a) an amino acid sequence comprising a beta-expansion, said sequence being identifiable by isolating a vegetative homolog of the group I grass pollen allergens;

- b) inferring a phylogenetic relationship of said beta-expansin protein to the phylogenetic tree of Figure 4, said tree having been prepared from the reference sequences shown in Figure 5, with the use of sequence analysis software; and
- c) locating the placement of said sequence with respect to the initial branch point, as
5 shown in Figure 4;
- d) characterizing said beta-expansin by the functional characteristics of inducing extension or stress relaxation of a plant cell wall material,
- e) determining the sequence to be said beta-expansin by falling within the branch
10 point comprising group I grass pollen allergens and homologs as opposed to an alpha-expansins.

36. The composition of claim 35 wherein said functional characteristic of a plant cell wall is selected from the group consisting of:

loosening or expanding cell walls, altering cell wall mechanical strength, altering the bonding
15 relationship between the components of the cell wall and altering the growth of the plant cell wall.

37. The composition of claim 35 wherein said functional characteristic may be determined using assays including, but not limited to, cell wall extension and stress relaxation
20 assays.

38. The amino acid sequence protein as in claim 35 having a property of inducing extension or stress relaxation of a plant cell wall material, said protein having an amino acid sequence with conserved amino acids as shown in Figure 5, when said sequence is aligned
25 with the conserved regions from the group comprising: a Thr Trp Tyr Gly motif and a Gly Gly Ala Cys Gly motif and a His Phe Asp Leu Ser Gly motif and a His Phe Asp motif using BLAST or FASTA algorithms (when compared to alpha-expansins).

39. A composition comprising a beta-expansin, said composition having a property of
30 inducing extension or stress relaxation of a plant cell wall material wherein said beta-expansin comprises 25% or less sequence similarity by BLAST or FASTA algorithms to alpha-expansin sequences as shown in Figure 5, said beta-expansin further having one or more functional characteristics of said beta-expansin such as inducing extension or stress

relaxation on monocotyledonous cell walls more effectively than on dicotyledonous cell walls as determined by cell wall extension and stress relaxation assays.

40. The composition of claim 39, wherein said beta-expansin comprises an amino acid
5 sequence selected from the group consisting of SEQ ID NO:10, SEQ ID NO:11, SEQ ID
NO:12, SEQ ID NO:13, SEQ ID NO:14 and SEQ ID NO:15.